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**Pendergraft et al.**

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(54) **MODULAR HEATING AND COOLING ELEMENTS FOR CONTROLLING TEMPERATURE OF MATERIALS IN A FLOWABLE STATE**

6,486,445 B1 11/2002 Pendergraft  
6,903,308 B2 6/2005 Pendergraft  
7,196,293 B2\* 3/2007 Britto ..... H01R 13/7038  
219/387

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7,914,277 B1 3/2011 Burrows et al.  
2004/0074891 A1\* 4/2004 Pendergraft ..... B29C 45/74  
219/424  
2007/0056950 A1\* 3/2007 Yudovsky ..... F27B 5/04  
219/406

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2007/0222125 A1 9/2007 Grajewski  
2009/0056856 A1 3/2009 Taylor et al.  
(Continued)

(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 323 days.

**FOREIGN PATENT DOCUMENTS**

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JP 3709988 10/2005  
JP 2014034125 2/2014  
WO WO2008002022 1/2008

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**OTHER PUBLICATIONS**

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International Search Report and Written Opinion from Corresponding PCT Patent Application PCT/US2015/055851; dated Jan. 25, 2016; Korean Intellectual Property Office.

(51) **Int. Cl.**

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**B29C 47/00** (2006.01)  
**B29C 47/08** (2006.01)

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(52) **U.S. Cl.**

CPC ..... **B29C 47/822** (2013.01); **B29C 47/0009** (2013.01); **B29C 47/0818** (2013.01); **B29C 47/825** (2013.01); **B29C 47/827** (2013.01)

(74) *Attorney, Agent, or Firm* — Head, Johnson, Kachigian & Wilkinson, PC

(58) **Field of Classification Search**

CPC ..... B29C 47/0009; B29C 47/0818; B29C 47/825; B29C 47/822; B29C 47/827  
USPC ..... 219/526; 165/11.1, 48.1  
See application file for complete search history.

(57) **ABSTRACT**

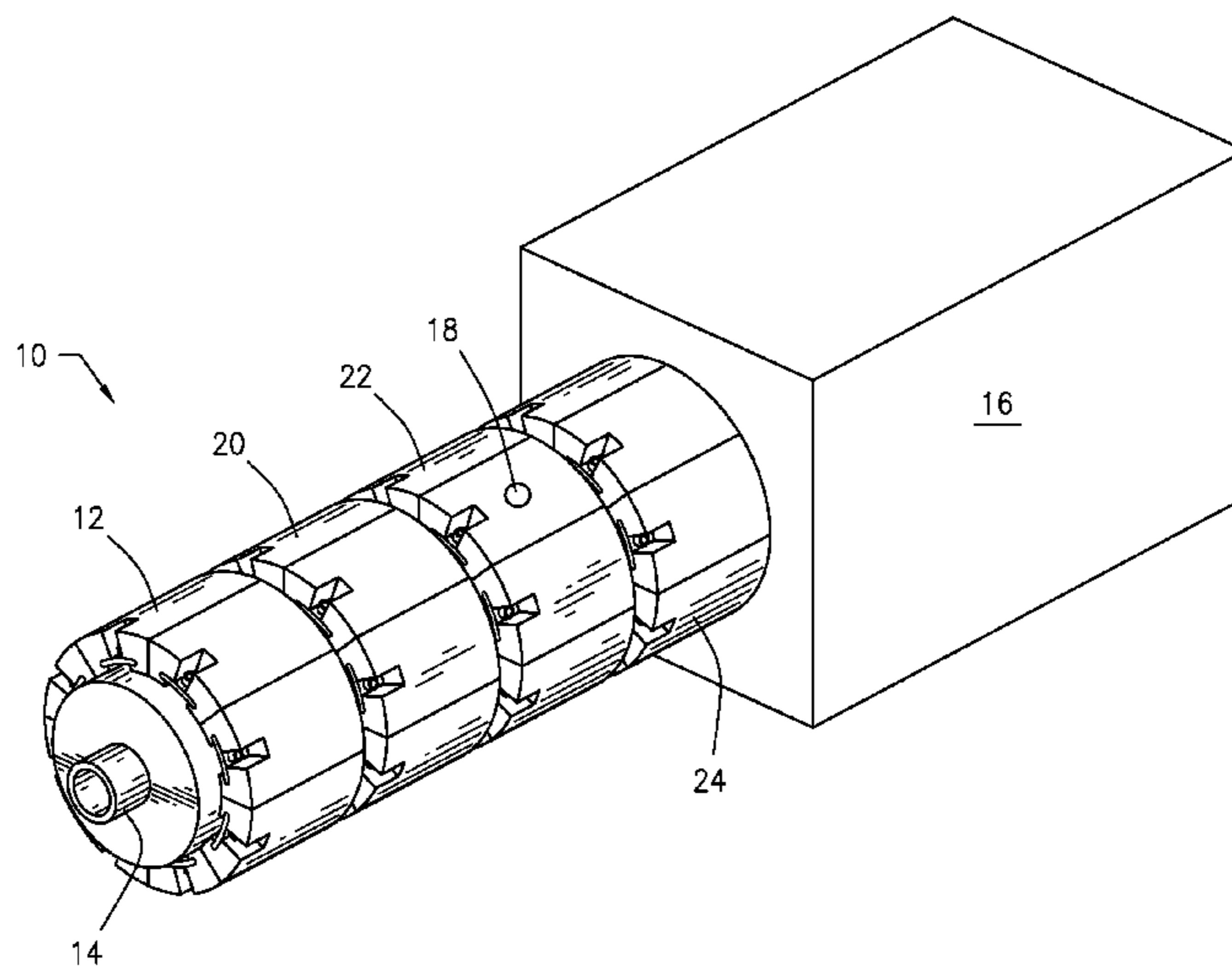
An apparatus for controlling temperature of materials in a flowable state as they flow through a barrel. The apparatus includes a band surrounding the barrel having a plurality of connected blocks, each block having an inner surface in communication with the barrel. One or more of the connected blocks has a slot therein and has a removable, temperature controlling mechanism slidably received in the slot. A flexible cover surrounds an outer surface of the band with the flexible cover having a pouch for receiving a temperature sensing element.

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

1,985,830 A \* 12/1934 Hynes ..... F24H 1/102  
392/471  
5,974,227 A 10/1999 Schave

**11 Claims, 6 Drawing Sheets**



(56)

**References Cited**

U.S. PATENT DOCUMENTS

2011/0005647	A1*	1/2011	Campfield .....	B65D 65/10
				150/154
2011/0221088	A1	9/2011	Fuse	
2012/0193347	A1*	8/2012	Schwartz .....	F24J 1/00
				219/482

\* cited by examiner

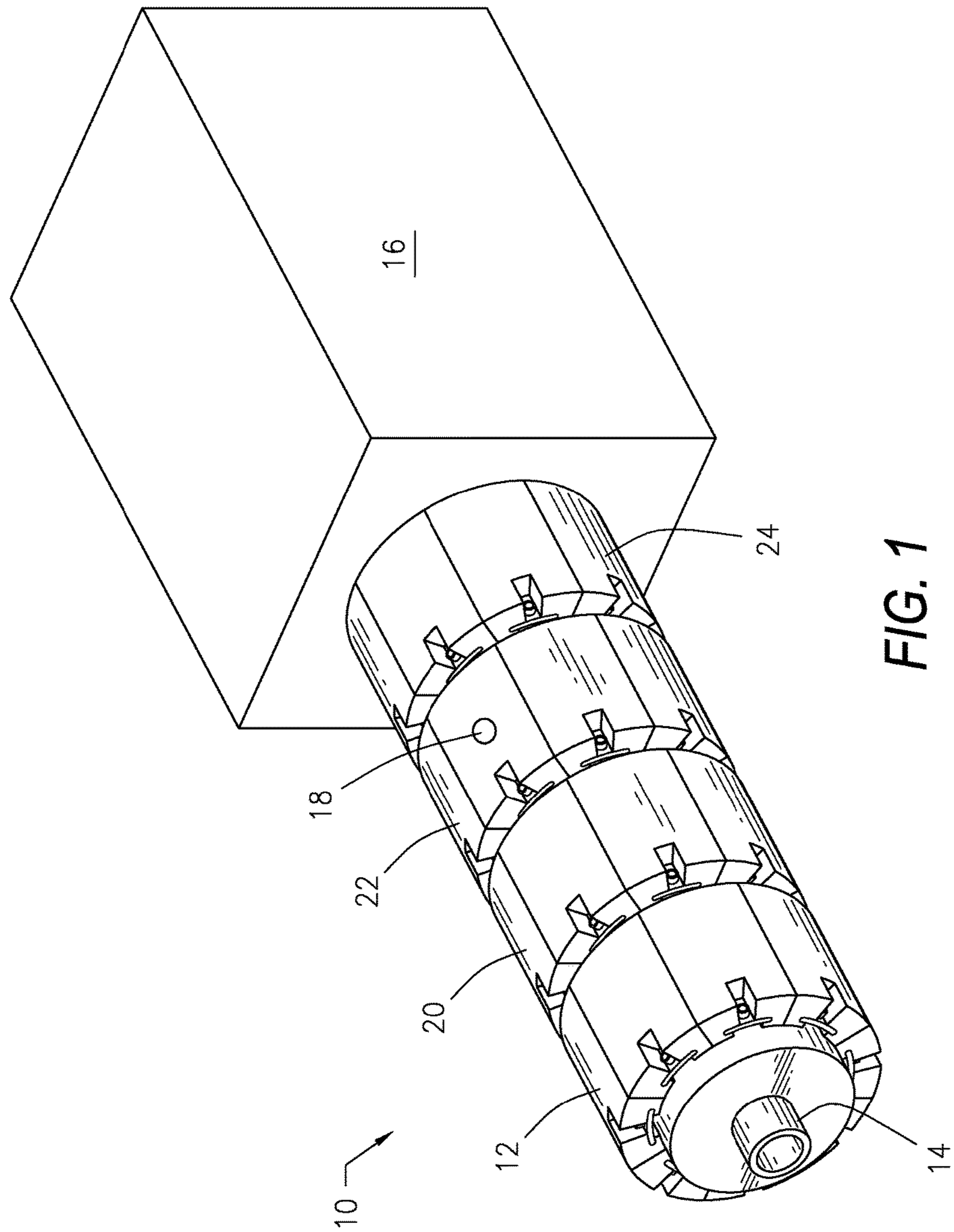
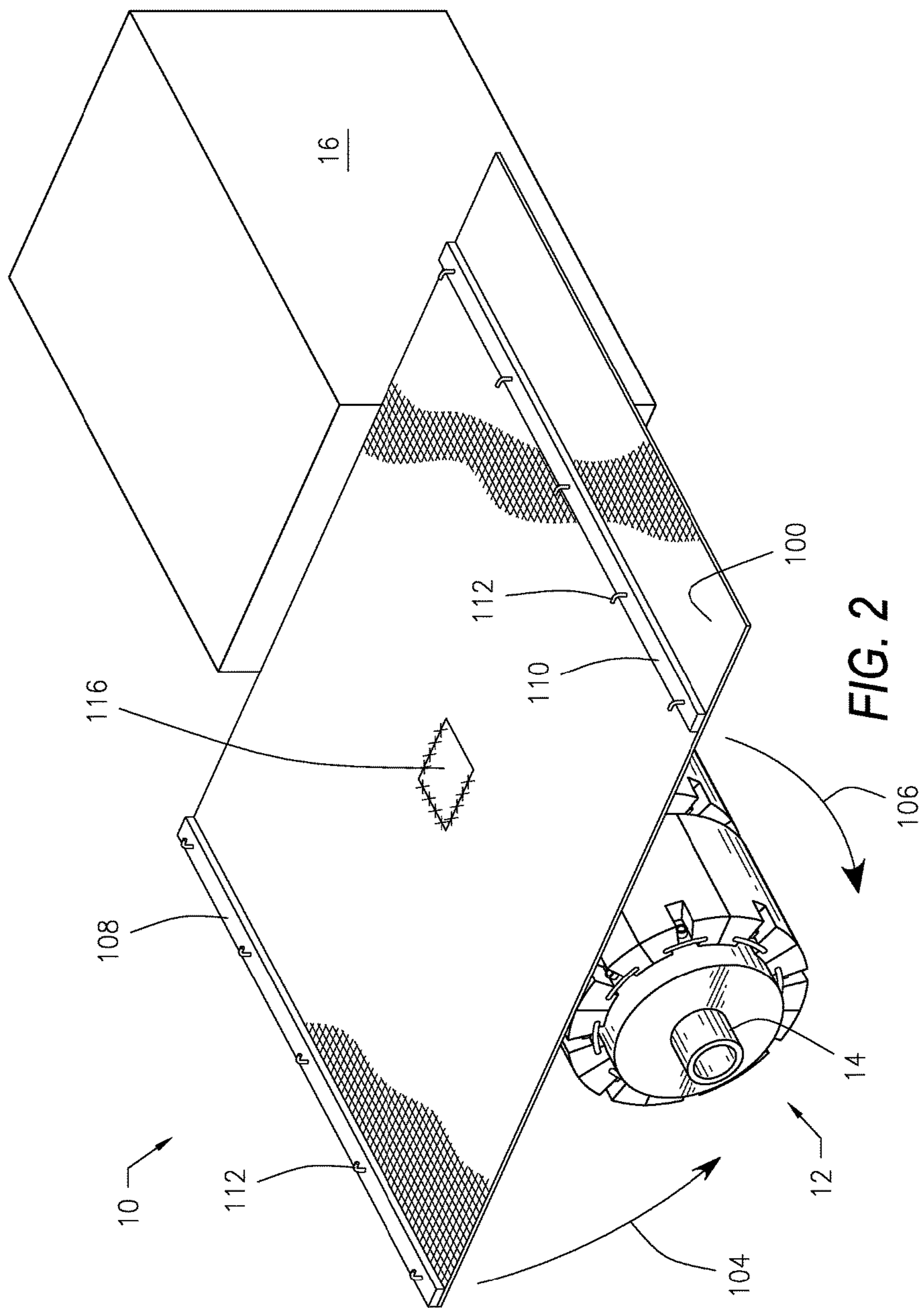
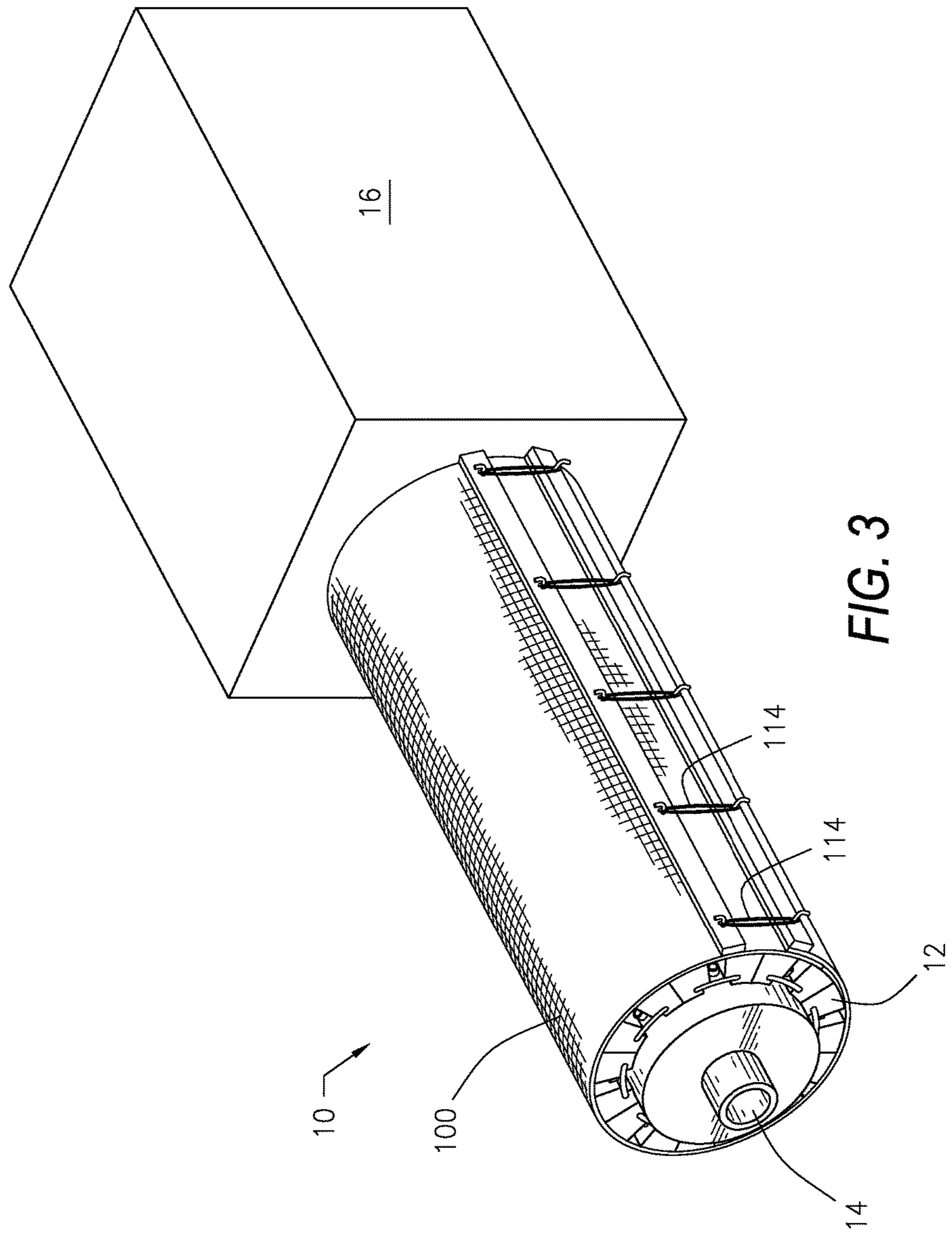


FIG. 1







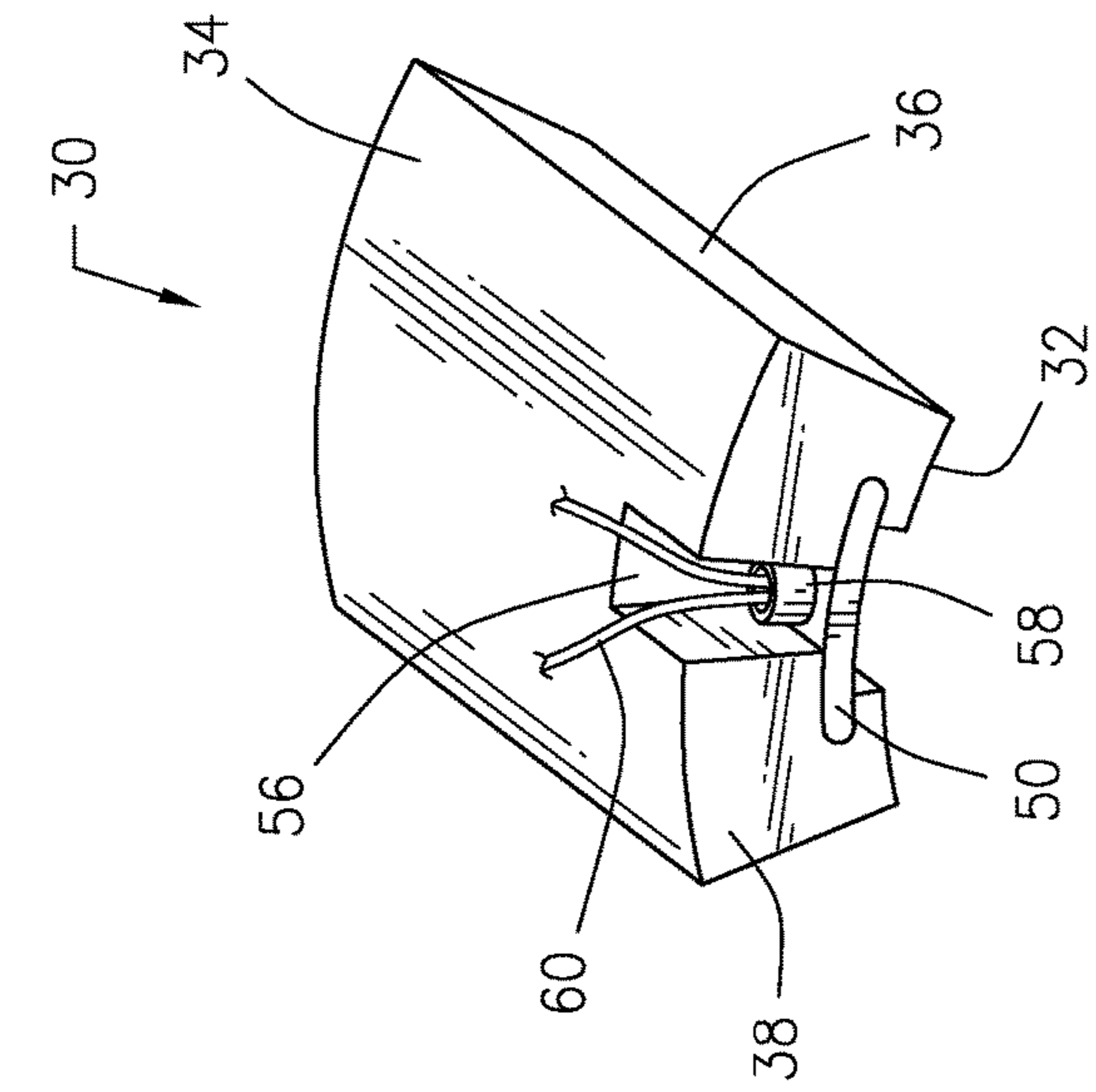


FIG. 5

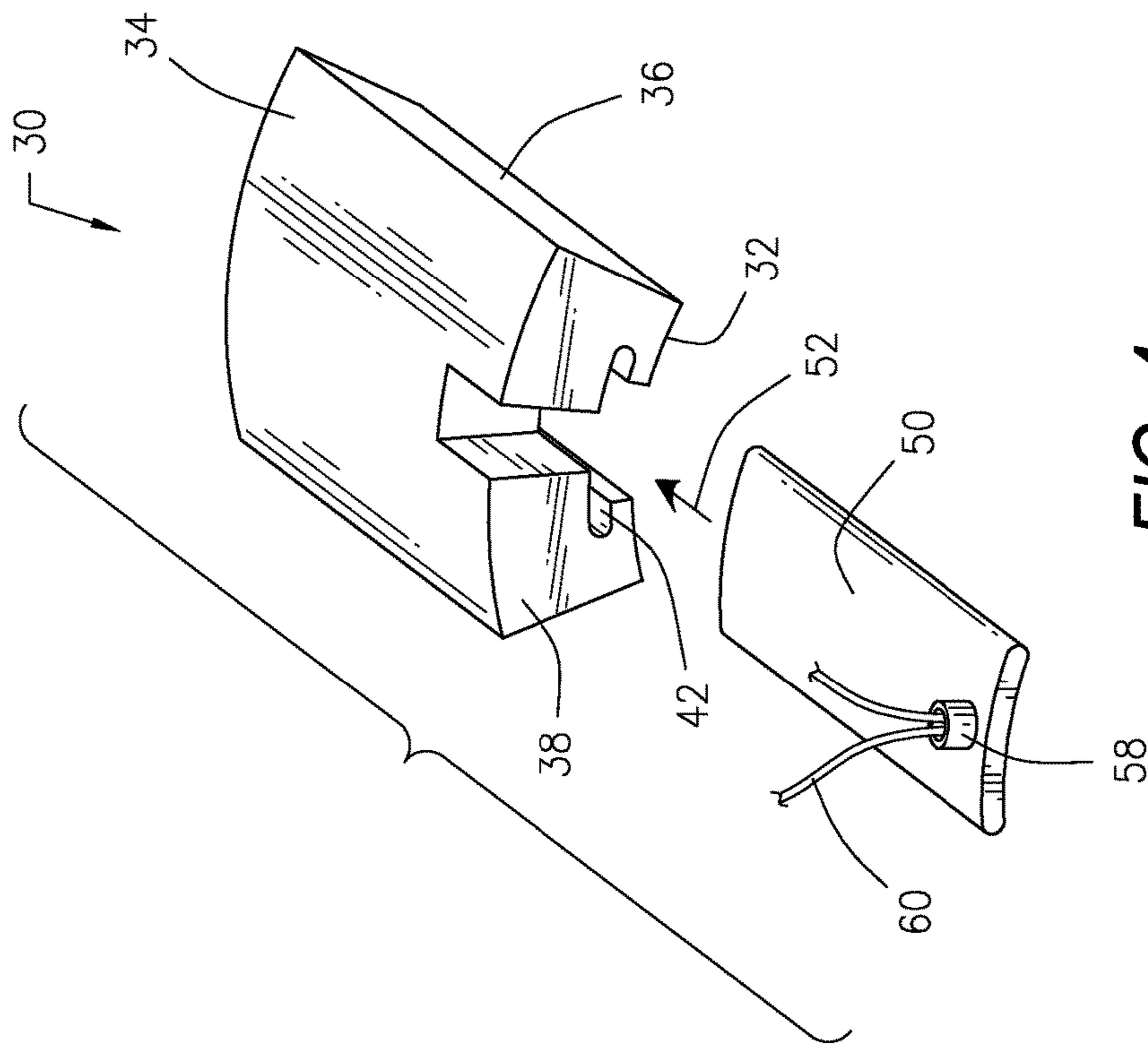
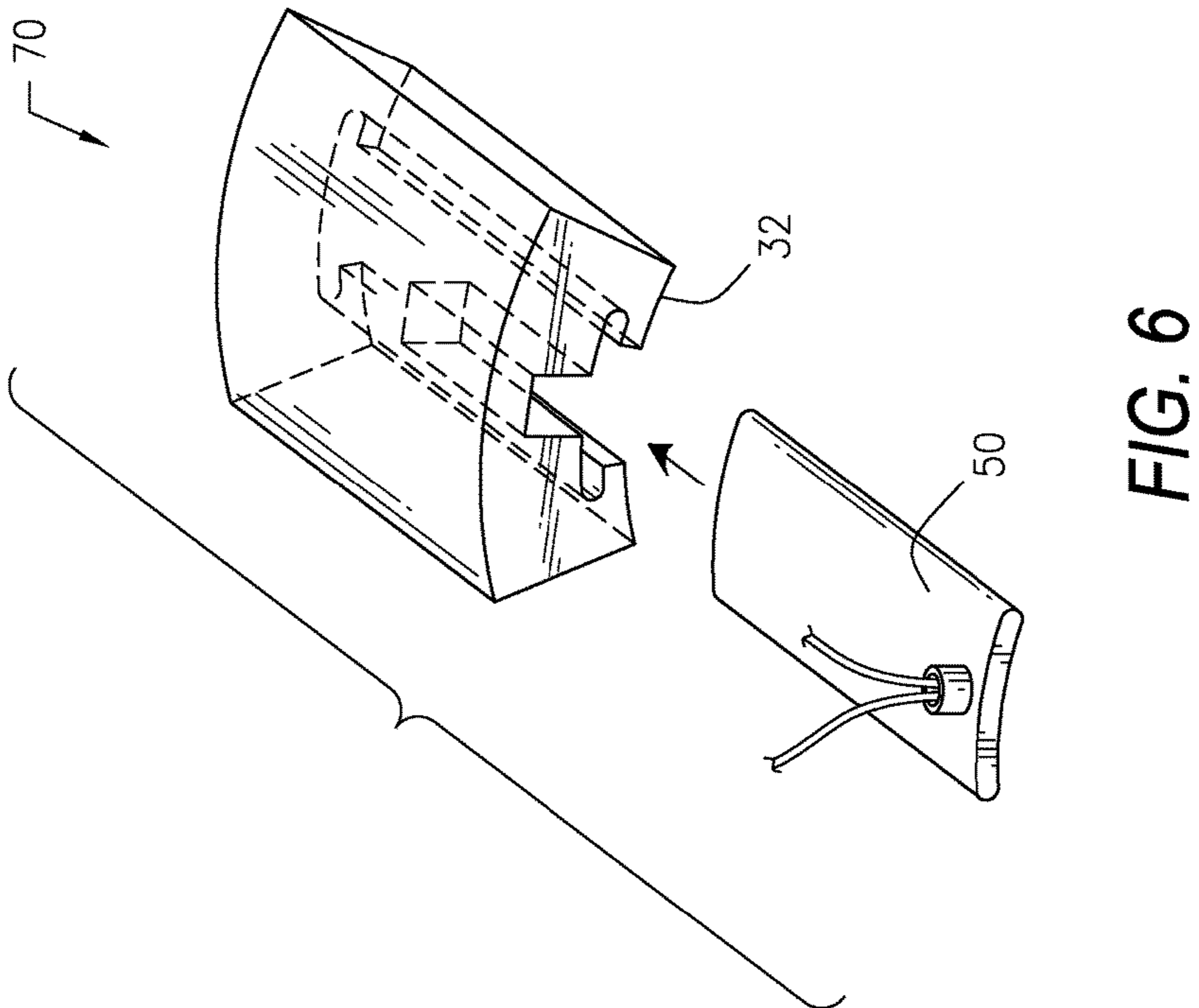
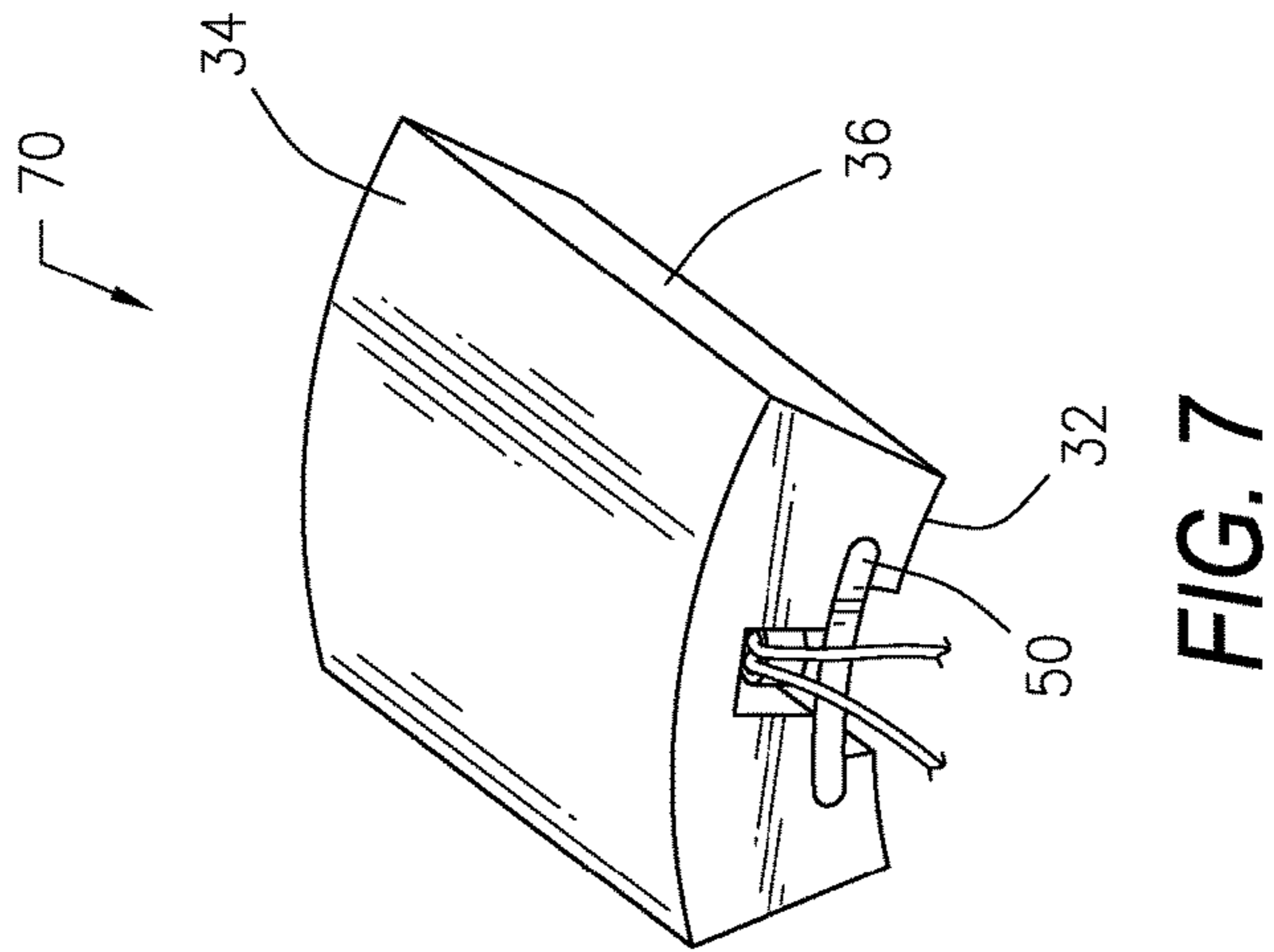


FIG. 4



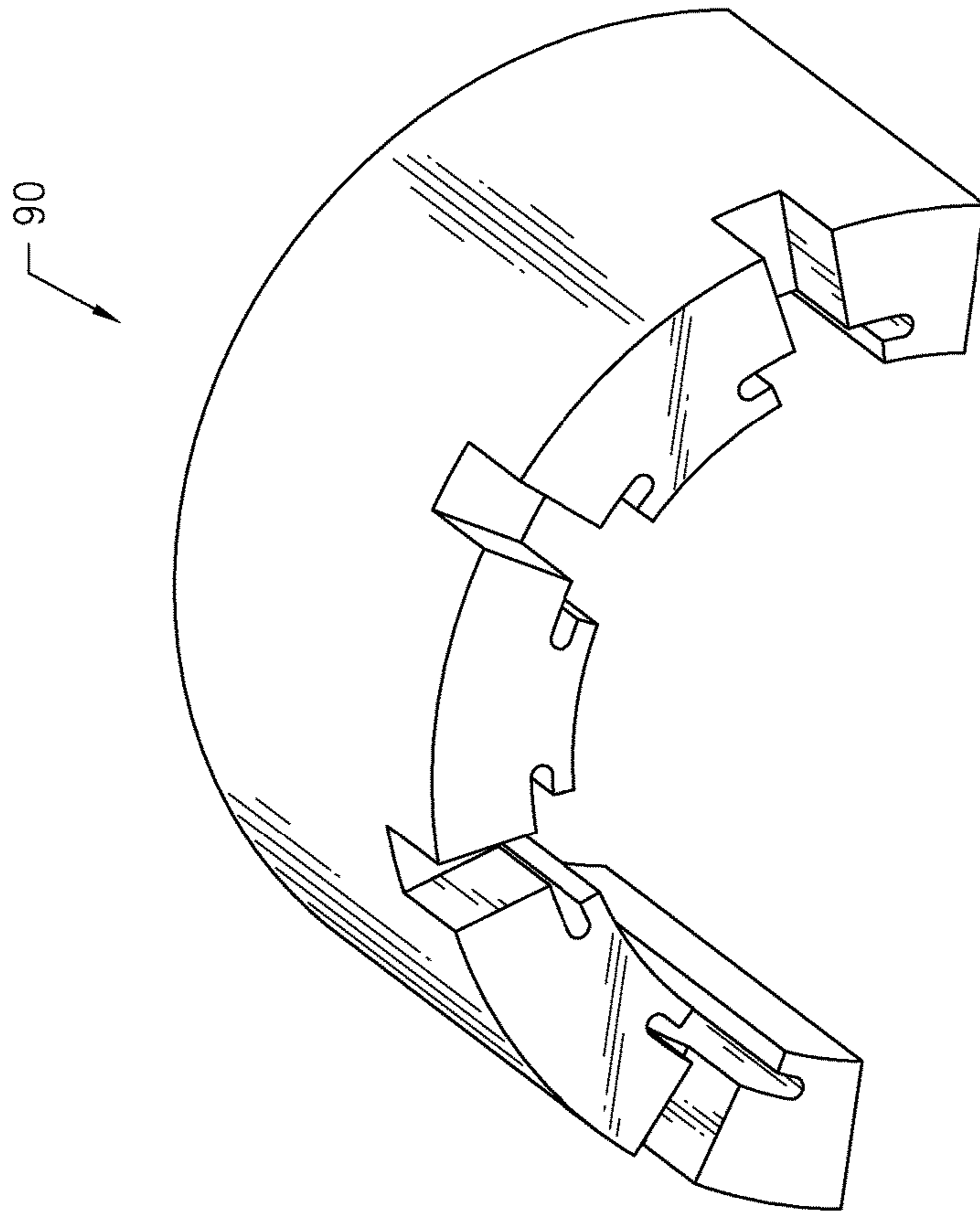


FIG. 9

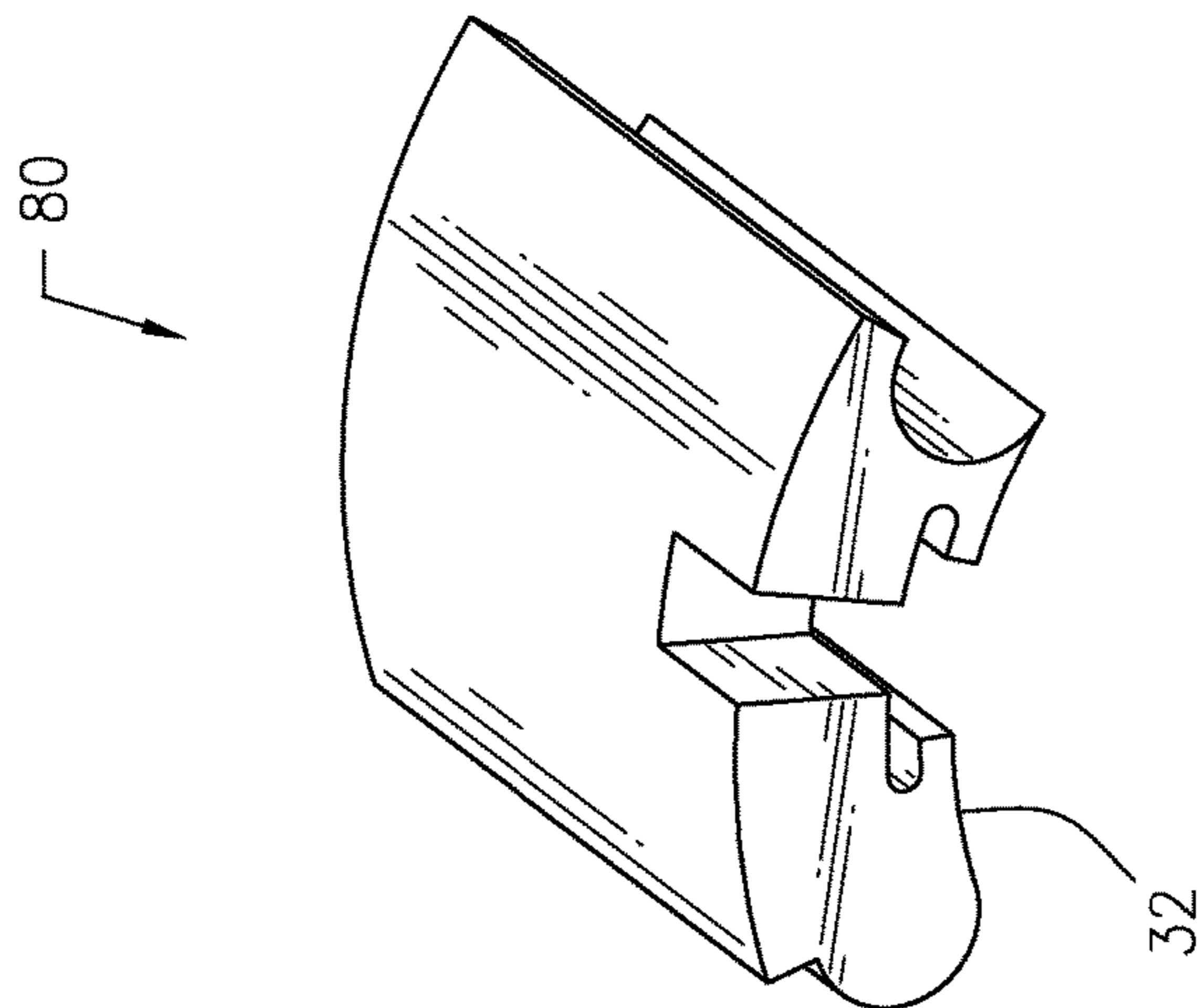


FIG. 8



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**MODULAR HEATING AND COOLING  
ELEMENTS FOR CONTROLLING  
TEMPERATURE OF MATERIALS IN A  
FLOWABLE STATE**

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an apparatus for controlling the temperature of materials in a flowable state as they flow through a barrel and for insulating the barrel. In particular, the present invention is directed to modular heating and cooling elements for controlling temperature utilizing removable and replaceable heating or cooling elements.

2. Prior Art

It is known in the plastics and polymer industries to utilize injection and/or extrusion equipment to form or manufacture components and products. Plastic or polymer resins along with additives are subjected to hot temperatures in order to convert the plastic or polymer resins into a flowable material. The material is injected or forced under pressure through a barrel before directing into a mold cavity or die. The barrel may include a rotating screw which mixes the materials and moves them through the barrel. Thereafter, the molten plastic or resin leaves the barrel and enters the mold or die.

In order to insure optimum flow characteristics, the barrels are often equipped with heating or cooling mechanisms in order to control the temperature of the compound. Assignee's prior patent, U.S. Pat. No. 6,486,445, entitled "Vacuum Cast Ceramic Fiber Insulated Band Having Heating and Cooling Elements," illustrates an example of a ceramic fiber insulated band. The flow characteristics of the fluid material are dependent upon the ability to control the heat applied to the barrel as the fluid passes therethrough.

Notwithstanding the foregoing, it would be desirable to provide an apparatus for controlling the temperature of materials in a flowable state as they flow through a barrel wherein individual temperature controlling mechanisms are removable and replaceable.

In addition, it would be desirable to provide an apparatus for controlling the temperature of materials in a flowable state as the materials flow through a barrel wherein a cover or jacket surrounds the band of the apparatus to protect the band from damage or dirt and to provide a receptacle for a temperature sensing element.

SUMMARY OF THE INVENTION

The present invention is directed to an apparatus for controlling the temperatures of materials in a flowable state. The apparatus surrounds and encases a barrel as the materials pass therethrough.

The band entirely surrounds and circumnavigates the barrel in order to provide a heating and/or cooling mechanism. In addition, the band serves to insulate the barrel and protect the barrel.

Each band includes a plurality of adjacent connected blocks. Each block includes an inner surface in communication with an outer surface of the barrel. Each block also includes an outer surface from and opposed to the inner surface. Each block also includes a pair of opposed side surfaces which mate with side surfaces from adjoining blocks.

Each block includes an arcuate slot which is accessible through an opening in a first end of the block. The arcuate

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slot is also in communication through an opening with the inner surface of the block. A removable temperature controlling mechanism is received in the slot.

A flexible cover may be installed around the band. The cover includes a pair of opposed slats. Hooks or other fasteners project from each of the slats. When the cover is wrapped around the band, the hooks on the slats will be opposed to each other. A strap or straps, such as an O-ring or similar connector, secures the hooks in order to keep the cover in place. A pouch may be provided in the flexible cover to receive a temperature sensing element.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a perspective view of an apparatus for controlling the temperature of materials in a flowing state constructed in accordance with the present invention;

FIG. 2 illustrates a perspective view of the apparatus as set forth in Claim 1 including a flexible cover for surrounding an outer surface of a band of said apparatus shown prior to installation;

FIG. 3 illustrates the apparatus as set forth in Claim 1 with the flexible cover installed around the band;

FIGS. 4 and 5 illustrate an example of a first preferred embodiment of a block of the band of the apparatus illustrating insertion of a removable temperature control mechanism;

FIGS. 6 and 7 illustrate a second preferred embodiment of a block of the band of the apparatus illustrating insertion of a removable temperature controlling mechanism;

FIG. 8 illustrates a third preferred embodiment of a block of the band of the apparatus; and

FIG. 9 illustrates a fourth preferred embodiment of a block of the band of the apparatus.

DETAILED DESCRIPTION OF THE  
PREFERRED EMBODIMENTS

The embodiments discussed herein are merely illustrative of specific manners in which to make and use the invention and are not to be interpreted as limiting the scope of the instant invention.

While the invention has been described with a certain degree of particularity, it is to be noted that many modifications may be made in the details of the invention's construction and the arrangement of its components without departing from the spirit and scope of this disclosure. It is understood that the invention is not limited to the embodiments set forth herein for purposes of exemplification.

Referring to the drawings in detail, FIG. 1 illustrates a perspective view of a first preferred embodiment of an apparatus 10 for controlling the temperature of materials in a flowable state. The apparatus 10 surrounds and encases a barrel 14. The barrel 14 may include a rotating screw (not shown) to move the materials therethrough.

The raw materials which are used for the parts or components to be molded or manufactured are mixed and prepared within a plastic injection and/or extrusion machine 16. In one non-limiting example, plastics beads are fed into the injection and/or extrusion machine 16 along with colorants or other additives.

During the injection or extrusion process, the ability to maintain control over the temperature of the material is critically important. The materials pass from the machine 16 through the barrel 14 and into a mold or die (not shown) at the opposed end of the barrel 14.



In the present embodiment, the barrel **14** is in the form of a cylinder although other embodiments, such as a square or oval cross section are possible within the spirit and scope of the invention.

The band **12** entirely surrounds and circumnavigates the barrel **14**. The band **12** completely encases the barrel **14** and, as will be described in detail, provides a heating and/or cooling mechanism. In addition, the band **12** serves to insulate the barrel **14** to retain the heat therein. Finally, the band **12** serves to protect the barrel **14** from damage.

In the preferred embodiment shown in FIG. **1**, the apparatus includes four bands, **12**, **20**, **22** and **24**, which are axially aligned with each other and also axially aligned with the barrel **14**. Each band may be maintained at the same temperature or alternatively, the bands may be maintained at different temperatures.

Each band includes a plurality of aligned and adjacent connected blocks **30**. When installed, the blocks **30** form an annular band around the barrel. The blocks **30** are composed of an insulating material, such as, but not limited to, vacuum cast ceramic fiber material. Each block **30** has an inner surface which mates with and is in communication with the barrel **14**.

In the present embodiment, the band **12** includes eight adjoining blocks **30**, although a greater or lesser number may be employed within the spirit and scope of the invention.

The individual blocks **30** may be held together by a securing mechanism, such as a cord or fastener.

As an option, one or more of the blocks **30** may include a temperature sensing element **18**.

A first preferred configuration of an individual block **30** is shown in FIG. **4** and in FIG. **5**, apart from the apparatus **10** as a whole.

Each block **30** includes an inner surface **32** which is in communication with and mates with an outer surface of the barrel **14**. Each block **30** also includes an outer surface **34** spaced from and opposed to the inner surface **32**. Each block **30** also includes a pair of opposed side surfaces **36** which mate with side surfaces from adjoining blocks **30**.

In addition, each block **30** includes a first end **38** and a second opposed end (not visible).

Each block **30** includes an arcuate slot **42** accessible through an opening in the first end **38** of the block **30**. The arcuate slot **42** is also in communication with the barrel through an opening with the inner surface **32** of the block **30**.

A removable temperature controlling mechanism **50** is slidably received in the slot **42**. FIG. **5** shows the temperature control mechanism **50** inserted into the block **30** while FIG. **4** illustrates the temperature controlling mechanism **50** exploded therefrom. Arrow **52** illustrates the direction for slidable insertion of the temperature controlling mechanism **50**. The temperature controlling mechanism is removed in the opposite direction.

Each block **30** also includes a notch **56** in the outer surface **34** of the block **30**, which notch **56** is in communication with the slot **42**. The notch **56** receives a projection **58** from the temperature control mechanism **50**, which provides space for the leads **60**. The leads are in communication with a power source and a control mechanism (not shown).

The temperature control mechanism **50** may take many configurations. In one configuration, the temperature control mechanism is an electric heating element. In another configuration, the temperature control mechanism is a cooling element. Air or liquid may be passed through the cooling element.

FIGS. **6** and **7** show a second preferred alternate configuration for a block **70**. FIG. **7** shows the temperature control mechanism inserted into the block **30** while FIG. **6** illustrates the temperature control mechanism **50** exploded therefrom.

FIG. **8** shows yet a further, third preferred embodiment of a block **80** having a tongue and groove arrangement. One side of the block **80** has a tongue while the opposed side has a groove. Finally, FIG. **9** shows a fourth preferred arrangement of a block **90** in a hemispherical configuration.

FIG. **2** illustrates a perspective view of the apparatus **10** with a flexible cover **100** shown prior to being installed around the bands. The flexible cover **100** may be fabricated from fiberglass or other material. The cover may be composed of a single sheet of material or a pair of sheets with insulation therebetween. The flexible cover **100** has a length which is as long as or, in the present embodiment, longer than the circumference of the band **12**. In order to install, the flexible cover **100** will be wrapped around the outer surface of the bands. Arrows **102** and **104** illustrate the direction of installation of the cover **100**.

FIG. **3** illustrates the flexible cover **100** installed around the bands of the apparatus **10**. The cover **100** includes a pair of opposed strips or slats **108** and **110**. Hooks or other fasteners project from each of the slats **108** and **110**. Accordingly, when the cover **100** is wrapped around the bands, the hooks on the slats **108** and **110** will be opposed to each other. A strap **114**, such as an O-ring or similar connector, will be used to secure to the hooks **112** to each other and keep the cover in place.

Returning to a consideration of FIG. **2**, a receptacle pouch **116** is provided in or on the cover **100** and may be sewn therein. The pouch **116** may have one open side in order to receive a temperature sensing element (not visible in the pouch). The temperature sensing element may take a number of configurations, including an analog or digital thermometer. The thermometer may have a transmitter therewith to transmit the temperature sensed to a receiver. Alternatively, or in addition thereto, the temperature sensing element may be connected to an alarm to sense a sound or other signal if the temperature exceeds a certain set point. Accordingly, the temperature on the outside of the band may be monitored, which will also provide an indication of the temperature in the barrel.

Whereas, the present invention has been described in relation to the drawings attached hereto, it should be understood that other and further modifications, apart from those shown or suggested herein, may be made within the spirit and scope of this invention.

What is claimed is:

**1.** An apparatus for controlling temperature of materials in a flowable state as it flows through a barrel and for insulating said barrel, said apparatus comprising:

- a band surrounding said barrel having a plurality of connected blocks, each block having an inner surface in communication with said barrel;
- one or more of said plurality of connected blocks having a slot therein;
- a removable heating element slidably received in said slot; and
- an opening in each said inner surface of each said block, wherein the opening is in communication with said slot such that the opening faces the barrel.

**2.** An apparatus as set forth in claim **1** wherein each said slot has an arcuate shape.

**3.** An apparatus as set forth in claim **1** wherein each said removable heating element has an arcuate shape.

**5**

4. An apparatus as set forth in claim 1 wherein each said block includes an outer surface opposed to said inner surface and wherein said outer surface includes a notch therethrough in communication with said slot.

5. An apparatus as set forth in claim 1 including a flexible cover surrounding an outer surface of said band, said flexible cover having a receptacle receiving a temperature sensing element.

6. An apparatus as set forth in claim 1 wherein said receptacle is a pouch.

7. An apparatus as set forth in claim 1 including a plurality of bands aligned with each other and axially aligned with said barrel.

8. An apparatus for controlling the temperature of materials in a flowable state as it flows through a barrel and for insulating said barrel, said apparatus comprising:

a band surrounding said barrel having a plurality of connected blocks;

**6**

one or more of said plurality of connected blocks having a slot therein and including a removable heating element slidably received in said slot and an opening in an inner surface of each said block, where the opening is in communication with said slot such that the opening faces the barrel;

a flexible cover surrounding an outer surface of said band, said flexible cover having a pouch; and  
a temperature sensing element received in said pouch.

9. An apparatus as set forth in claim 8 wherein said temperature sensing element is a thermometer.

10. An apparatus as set forth in claim 8 wherein said flexible cover is a sheet which is wrapped around said band and secured by fasteners.

11. An apparatus as set forth in claim 10 wherein said fasteners include:

a plurality of hooks extending from said cover; and  
a plurality of resilient rings.

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